

SUBCHAPTER C : LAND DISPOSAL OF SEWAGE EFFLUENT

§309.20. Land Disposal of Sewage Effluent.

(a) Technical report. Each project shall be accompanied by a preliminary engineering report outlining the design of the wastewater disposal system. The report shall include maps, diagrams, basis of design, calculations, and other pertinent data as described in this section.

(1) Location.

(A) Site map. A copy of the United States Geological Survey topographic map of the area which indicates the exact boundaries of the disposal operation will be included in the technical report. A map from the 7 1/2 minute series is required if it is published for the site area.

(B) Site drawing. A scale drawing and legal description of all land which is to be a part of the disposal operation will be included in the technical report. The drawing will show the location of all existing and proposed facilities to include: buildings, waste disposal or treatment facilities, effluent storage and tail water control facilities, buffer zones, and water wells. This drawing should have an index of wells, adjacent property, and other prominent features. Ownership of land tracts adjacent to the irrigated land shall be shown on the site drawing and identified by listing legal ownership.

(2) Geology. The existence of any unusual geological formations such as faults or sink holes on the waste disposal site shall be noted in the technical report and identified on the site map. The conceptual design of the waste disposal system shall include appropriate engineering considerations with respect to limitations presented by these features.

(3) Soils. A general survey of soils with regard to standard classifications shall be compiled for all areas of waste application to the soil. Soil surveys compiled by the United States Department of Agriculture Soil Conservation Service shall be utilized where available. Conceptual design aspects related to waste application rates, crop systems, seepage and runoff controls shall be based upon the soil physical and chemical properties, hydraulic characteristics, and crop use suitabilities for the waste application site.

(4) Groundwater quality. The technical report shall fully assess the impact of the waste disposal operation on the uses of local groundwater resources. In regard to performing this assessment, the report shall systematically address subparagraphs (A) and (B) of this paragraph.

(A) All water wells within a half mile radius of the disposal site boundaries shall be located. If available, the water uses from each well shall be identified. In addition, aspects of construction such as well logs, casing, yield, static elevation, water quality, and age shall be furnished and evaluated in the technical report. Local groundwater resources below the wastewater disposal site shall be monitored to establish preoperational baseline groundwater quality when monitoring wells are

available. Monitoring shall provide the following analytical determination: total dissolved solids, nitrate nitrogen, chlorides, sulfates, pH, and coliform bacteria.

(B) Groundwater resources serving as sources or potential sources of domestic raw water supply will be protected by limiting wastewater application rates. Effluent storage and/or treatment ponds presenting seepage hazards to these groundwater resources shall be constructed with adequate liners.

(5) Agricultural practice. The technical report shall describe the crop system proposed for the waste disposal operation. This description shall include a discussion of the adaptability of the crop to the particular soil, climatological, and wastewater sensitivity conditions that will exist at the waste disposal site. Annual nutrient uptake of the crop system shall be specified, and crop harvesting frequencies shall be described within the report.

(b) Irrigation. Irrigation disposal systems utilize effluent to supply the growth needs of the cover crop.

(1) Secondary effluent. Land disposal system operators who use land accessible to the general public shall provide a degree of treatment equivalent to secondary treatment standards, as defined by the commission, prior to application of waste to land areas.

(2) Primary effluent. Land disposal systems may provide for the disposal of effluent from primary treatment units provided that the wastewater disposal system conforms with the requirements contained in subparagraphs (A)-(E) of this paragraph.

(A) The wastewater disposal system shall be designed and operated to prevent a discharge from entering surface waters, and to prevent recharge of groundwater resources which supply or offer the potential of supplying domestic raw water.

(B) The land disposal system shall be designed and operated to achieve disposal of effluent without adversely affecting the agricultural productivity of the land disposal site.

(C) The economic benefits derived from agricultural operations carried out at the land disposal site are secondary to the proper disposal of wastewater.

(D) The sewerage system owner shall maintain direct responsibility and control over all aspects of the sewage pretreatment and application operations, as well as all aspects of any agricultural activities carried out on the disposal site.

(E) The land disposal system shall contain sufficient area to provide for normal expansion of the facility service area. In most cases, the disposal system shall have a design life of at least 20 years.

(3) Design analysis. The designing engineers shall utilize a detailed design analysis of limiting hydraulic and nutrient application rates, and effluent storage needs, as the basis of the disposal

system design. All projects shall include the detailed design analysis described in subparagraphs (A)-(C) of this paragraph.

(A) Hydraulic application rate. A water balance study shall be provided as a part of a detailed application rate analysis in order to determine the irrigation water requirement, including a leaching requirement if needed, for the crop system on the wastewater application areas. The water balance study should generally follow the example development shown in Table 1 of this subparagraph. Precipitation inputs to the water balance shall utilize the average yearly rainfall and the monthly precipitation distribution based on past rainfall records. The consumptive use requirements (evapotranspiration losses) of the crop system shall be developed on a monthly basis. The method of determining the consumptive use requirement shall be documented as a part of the water balance study. A leaching requirement, calculated as shown in Table 1 of this subparagraph, shall be included in the water balance study when the total dissolved solids concentration of the effluent presents the potential for developing excessive soil salinity buildup due to the long term operation of the irrigation system.

TABLE 1
WATER BALANCE EXAMPLE
(All Units are Inches of Water per Acre of Irrigated Area)

	a	b	Ri	c	d			e	f	g
Month	Avg.	Average	Average	Evapotrans-	Required	Total	Effluent	Evaporation	Effluent	Consumption
(1)	Precip.	Runoff	Infiltrated	piration	Leaching	Water	Needed	from Reservoir	to be	from
	(2)	(3)	Rainfall	(5)	(6)	Needs	in Root	Surface	Applied	Reservoir
			(4)			(5)+(6)	Zone		(8)/K	(9)+(10)
						(7)	(7)-(4)	(9)	(10)	(11)
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Jan.	2.11	0.40	1.71	0.80	0.00	0.80	0.00	0.02	0.00	0.02
Feb.	2.43	0.57	1.86	1.20	0.00	1.20	0.00	0.01	0.00	0.01
Mar.	2.02	0.36	1.66	2.80	0.20	3.00	1.34	0.09	1.58	1.67
April	3.19	1.03	2.16	3.40	0.22	3.63	1.46	0.05	1.72	1.77
May	4.19	1.74	2.45	6.10	0.64	6.74	4.29	0.10	5.05	5.15
June	3.30	1.10	2.20	6.50	0.76	7.26	5.06	0.20	5.95	6.15
July	2.20	0.45	1.75	6.70	0.87	7.57	5.82	0.34	6.85	7.19
Aug.	2.12	0.41	1.71	4.60	0.51	5.11	3.40	0.34	4.00	4.34
Sept.	3.58	1.30	2.28	5.10	0.50	5.60	3.32	0.19	3.91	4.10
Oct.	3.09	0.96	2.13	4.10	0.35	4.45	2.32	0.14	2.73	2.87
Nov.	2.23	0.46	1.77	2.10	0.06	2.16	0.39	0.07	0.46	0.53
Dec.	2.34	0.52	1.82	1.00	0.00	1.00	0.00	0.03	0.00	0.03
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	32.80	9.30	23.50	44.40	4.11	48.51	27.40	1.58	32.25	33.83

- a. Up-to-date rainfall and evaporation data sets are available from the Texas Natural Resource Information System.
- b. Runoff should be determined by an acceptable method such as the Soil Conservation Service method found in SCS Technical Release No. 55. For calculation purposes only, a CN value of 74 was assumed for good pasture with Class "C" soils.
- c. Suggested source of values is the "Bulletin 6019, Consumptive Use of Water by Major Crops in Texas", Texas Board of Water Engineers.
- d. In low rainfall areas, this is the required leaching to avoid salinity build-up in the soil where:

$$L = \frac{C_e (E - R_i)}{C_1 - C_e}$$

$$R_i = \text{Infiltrated Rainfall}$$

$$C_e = \text{Electrical Conductivity of Effluent}$$

$$C_1 = \text{Maximum Allowable Conductivity of Soil Solution (Table 3)}$$

$$E = \text{Evapotranspiration}$$

For calculation purposes only, C_e is measured to be 1.5 millimhos/cm @ 25°C and C_1 is 10.0 (Bermuda Grass)

- e. Net Average Evaporation from Reservoir Surface. For the purpose of this calculation, irrigation area = 100 acres and reservoir surface area = 5 acres. Therefore, values are 5% of Evaporation figures of Austin, Texas.
- f. K is the irrigation efficiency. K value is 0.85 unless specific information is provided to support a different value.
- g. The total of this column is the maximum allowable application rate in Acre-in./Ac./yr.

TABLE 2
EXAMPLE CALCULATION OF STORAGE VOLUME REQUIREMENTS
(All Units are Inches of Water per Acre of Irrigated Area)

Month (12)	a Effluent Received for Application or Storage (13)	b Rainfall Worst Year in Past 25 Year (14)	c Runoff Worst Year in Past 25 Year (15)	Infiltrated Rainfall (14)-(15) (16)	Available Water (13)+(16) (17)	d Net 25 Year Low Evaporation from Regur.Surf. (18)	e Storage (19)	f Accumulated Storage (20)
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Jan.	2.70	3.28	1.09	2.19	4.89	0.00	2.69	8.49
Feb.	2.70	3.80	1.45	2.35	5.05	0.01	2.69	11.18
Mar.	2.70	3.18	1.02	2.16	4.86	0.04	1.67	12.85
April	2.70	4.98	2.35	2.63	5.33	0.02	1.51	14.36
May	2.70	6.57	3.67	2.90	5.60	0.04	-1.86	12.50
June	2.70	5.13	2.47	2.66	5.36	0.09	-2.80	9.70
July	2.70	3.44	1.20	2.24	4.94	0.16	-3.73	5.97
Aug.	2.70	3.33	1.12	2.21	4.91	0.16	-0.87	5.10
Sept.	2.70	5.59	2.84	2.75	5.45	0.08	-0.74	4.36
Oct.	2.70	4.82	2.22	2.60	5.30	0.07	0.45	0.45
Nov.	2.70	3.49	1.23	2.26	4.96	0.03	2.67	3.12
Dec.	2.70	3.64	1.34	2.30	5.00	0.02	2.68	5.80
—	32.40	51.25	22.00	29.25	61.65	0.73		

- a. For calculation purposes only, disposal rate is for a 240,000 gpd facility (2.7 Ac.-ft/AC./yr.) irrigating 100 Acres. Maximum values for Column 13 are the value (total) of Column 11 divided by 12. Note that the values in Column 13 could be adjusted to allow for seasonal variation in effluent output.
- b. Annual rainfall amount from the worst year in past 25 years of data. Total rainfall is then distributed proportional to monthly averages.
- c. Using rainfall figures in Column 14, calculate runoff with the same method used in Column 3.
- d. Lowest annual evaporation in past 25 years from reservoir surface. Distribute annual value proportionally to monthly average evaporation expressed in inches per irrigated acre. For purpose of this calculation, irrigation area = 100 acres and reservoir surface area = 5 acres. Therefore, values in Column 18 are 5% of Evaporation figures for Austin, Texas.
- e. $\text{Storage} = [(13)-(18)] - \{[(7)-(16)]/k\}$. If the term $\{[(7)-(16)]/k\}$ is negative, then the value for storage = $[(13)-(18)]$. Irrigation efficiency is 0.85 unless specific information is provided to support a different value.
- f. To allow for the worst condition, the summation was started in Oct. which gives a maximum storage requirement of 14.36 in./irrigated acre or 120 Acre-feet.

TABLE 3
Salt Tolerance of Various Crop Plants

Best growth yields of each crop would occur at a salinity level below the salinity range given.

Relatively Nontolerant	Moderately Salt Tolerant	Relatively Salt Tolerant	Highly Salt Tolerant
Electrical Conductivity (millimhos/cm at 25 degrees C)			
2.0 - 4.0	4.0 - 6.0	6.0 - 8.0	8.0 - 12.0
Field Crops			
Field bean Cowpeas Corn (field)	Sorghum (grain) Rye (grain) Castorbean Soybean	Cotton Sugar beet Wheat (grain) Oats (grain) Rice	Barley (grain) Rape
Forage Crops			
White clover Alsike clover Red clover Ladino clover Crimson clover Rose clover Burnet clover	Tall fescue Meadow fescue Orchard-grass Millet Sour clover Birdsfoot trefoil	Wheat-grasses Sudan grass Sweetclover Alfalfa Ryegrass Rye (hay) Wheat (hay) Oats (hay)	Alkali sacaton Bermuda grass Barley (hay) Rhodesgrass Blue grama Panicgrass

(B) Effluent storage. An effluent storage study shall be performed to determine the necessary storage requirements. The storage requirements shall be based on a design rainfall year with a return frequency of at least 25 years (the expected 25 year - one year rainfall, alternately the highest annual rainfall during the last 25 years of record may be used) and a normal monthly distribution, the application rate and cycle, the effluent available on a monthly basis, and evaporation losses. An example of an effluent storage study is shown in Table 3 of this subparagraph.

(C) Nitrogen application rate. Irrigation shall be limited to prevent excessive nitrogen application. The annual liquid loading shall not exceed that which would introduce more nitrogen than is annually required by the crop plus 20% volatilization. Values of crop nitrogen requirements shall be justified in the design report. The application rate shall be calculated by the formula

$$L = \frac{N}{2.7C} \text{ where,}$$

L = annual liquid loading - feet/year
C = effluent nitrogen concentration - mg/l
N = annual crop requirement of nitrogen plus 20% volatilization
pound/acre/yr.

(4) Soil testing. Representative soil samples shall be taken from the root zones of wastewater application sites to establish pre-operational soil concentrations of pH, total nitrogen, potassium, phosphorus, and conductivity. Sampling procedures shall employ accepted techniques of soil science for obtaining representative analytical results. Base-line values of the parameters specified in paragraph 3(C) of this subsection shall be furnished in the technical report. The project development shall provide for a minimum of one soil test annually from each wastewater application site for the duration of the disposal system design life.

(5) Standard irrigation best management practices.

(A) Screening devices should be installed on all lift pump suction intakes.

(B) The design of sprinkler irrigation systems should allow operational flexibility and efficiency and ease of maintenance.

(i) The system should be designed to provide a uniform water distribution.

(ii) The designing engineer should consider such items as permanently buried mains with readily accessible valve boxes, two or more lateral lines, and quick coupling valves at the main/lateral connections.

(iii) Cross connection with a potable water supply system is prohibited. Cross connection with a well water system will be reviewed on a case-by-case basis.

(C) Vehicular access to conveyance system locations and equipment should be provided at intervals of 1,000 feet to 1,300 feet.

(D) The cover crop of each wastewater application area shall be harvested a minimum of once per year. Consideration should be given to the selection of crops which will allow two or more harvests per year to be made.

(E) All effluent applied as irrigation water should have a pH within the range of 6.0 to 9.0.

(c) Percolation. Percolation disposal systems provide for ultimate disposal of the wastewater by evaporation and percolation with no resulting discharge to surface waters.

(1) Percolation systems will not be permitted in those locations where seepage would adversely affect the uses of groundwater resources.

(2) Primary treatment of the raw sewage shall be provided prior to land disposal.

(3) Percolation systems shall be limited to sites having soil textures suitable for sustaining a rapid intake rate. Percolation dosing sites shall be limited to soils classified as sands, loamy sands, or sandy loams having a minimum infiltration rate of six inches per hour.

(4) Multiple dosing basins shall be provided for the application of wastewater. The wastewater distribution system shall be designed to provide a maximum dosing period of 24 hours upon any individual dosing basin and a minimum resting period for any individual dosing basin of five days following a period of dosing.

(5) The hydraulic loading rate will be considered on a case-by-case basis. The designing engineer shall identify the permeability of the limiting soil layer.

(6) The design shall provide an area equal to a minimum of 20% of the total disposal site area for the construction of wastewater storage for utilization during periods of wet or freezing weather and to provide flexibility of dosing site utilization.

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